GEORGE

LEHIGH EARLY STRENGTH CEMENT

What it is, what it does what it can be used for

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LEHIGH EARLY STRENGTH CEMENT

What it is, what it does, what it can be used for

LEHIGH
CEMENT

LEHIGH PORTLAND CEMENT COMPANY
Allentown, Pa., Chicago, Ill., Spokane, Wash.

LEHIGH EARLY STRENGTH CEMENT

Chemical Laboratory, Lehigh University, Bethlehem, Pa., was completed with Lehigh Early Strength Cement to get quick curing concrete before cold weather set in. Forms were removed and re-used in one-quarter the usual time—50 per cent was saved on form costs.

WILLERT PARK
LOW RENT HOUSING PROJECT NO N.Y. 2-2
DEVELOPED BY
MUNICIPAL HOUSING AUTHORITY

Contractors all over the country are having profitable experiences with Lehigh Early Strength Cement, similar to those enjoyed in the construction of this low-rent housing project at Buffalo, N. Y. Confronted with the problem of providing temporary heat for winter protection of concrete, they decided to use Lehigh Early Strength Cement to make quick curing concrete, and at the same time make the slabs quickly available for brick masonry operation.

FOREWORD

This book presents essential information from which all concerned with construction or the use of portland cement may determine the advantages of Lehigh Early Strength Portland Cement.

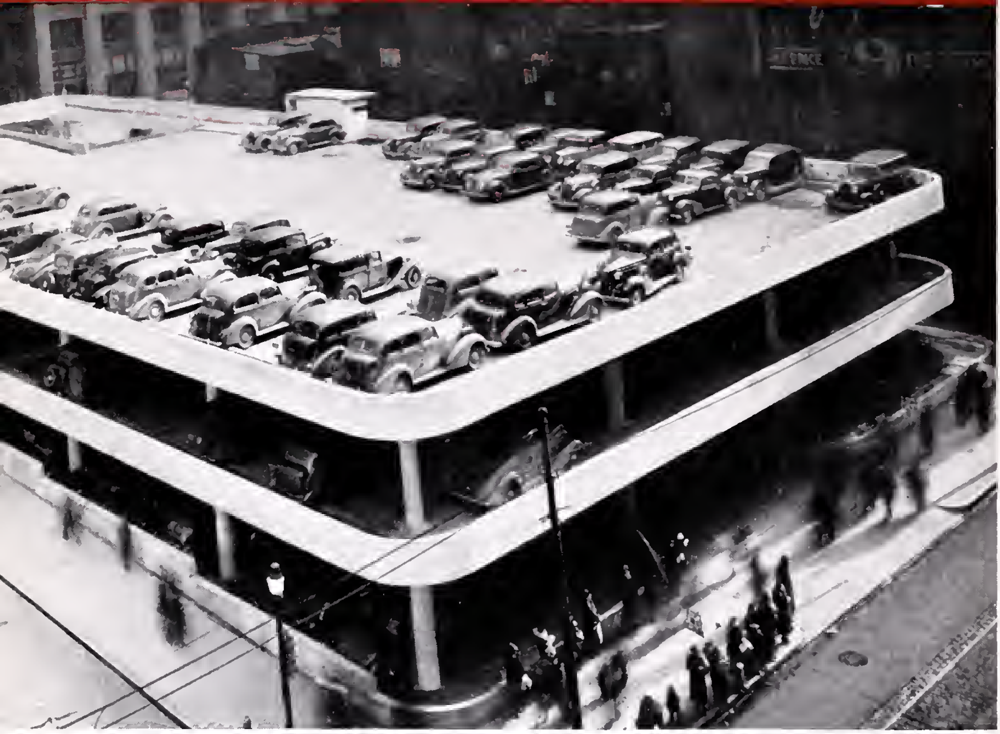
As in the case of normal portland cement, the use of Lehigh Early Strength Cement is predicated upon following all the well-known principles of mixing and placing concrete with sound design; clean, well-graded aggregate properly proportioned; and good workmanship.

Lehigh Early Strength Portland Cement conforms to Specification C74–39 of the American Society for Testing Materials for early strength portland cement.

Your assurance for the quality of Lehigh Early Strength Portland Cement is the name of the maker—a pioneer in American Portland Cement manufacture, nationally recognized for the dependability of its products.

LEHIGH PORTLAND CEMENT COMPANY
ALLENTOWN, PA. CHICAGO, ILL. SPOKANE, WASH.
Mills from Coast to Coast—Sales Offices in Principal Cities

LEHIGH EARLY STRENGTH CEMENT



Kaufmann's Department Store in Pittsburgh, Pa., had to provide parking space quickly for their customers. Lehigh Early Strength Cement was used in this three-story parking lot of concrete. Cars parked on lower floors 20 days earlier than otherwise possible, and on top tier two days after pouring concrete. Construction time was reduced 27 days. The concrete was of the highest quality, and absolutely waterproof.

Lehigh Early Strength Cement was used to make quick curing concrete to resist water pressure in early stages—dense concrete to resist water penetration—quick service strength concrete to speed up construction at Painesville, Ohio.

LEHIGH EARLY STRENGTH CEMENT

What it is, what it does, what it can be used for

What is Lehigh Early Strength Portland Cement?

Lehigh Early Strength Cement is a true portland cement. It is made from the same raw materials by the same process as normal Lehigh Cement and has all its characteristics. In addition it possesses the added property of developing full working strength in relatively much shorter time than normal portland cement. Modifications in composition and finer grinding in the manufacture of Lehigh Early Strength Cement cause an acceleration of the chemical reactions when the finished product is mixed with water.

It is used according to commonly known methods for making concrete of any mixture. The concrete made with it will harden to service strength three to five times as rapidly as a similar composition made under the same conditions with normal portland cement. For most uses, concrete made with Lehigh Early Strength Cement attains service strength in twenty-four hours or earlier. Like any concrete, its strength increases with age, and the use of Lehigh Early Strength Cement in no way affects the ultimate strength.

In addition, concrete made with Lehigh Early Strength Cement is of better workability and maximum density—concrete of the highest quality.

Because it makes quality concrete with maximum practicable speed, the use of Lehigh Early Strength Cement has many advantages for a large proportion of concreting operations which may be interpreted in terms of efficiency, economy, and convenience on every type of construction or repair work, large or small.

For Owners, Bankers, and Investors

The use of quick service strength concrete speeds up construction, resulting in earlier completion of the work and earlier occupancy for revenue-producing purposes. Cold weather construction is expedited by the use of Lehigh Early Strength Cement, with a reduction in expense for curing and protection against freezing. Repairs and alterations may be made quickly

LEHIGH EARLY STRENGTH CEMENT

OPENED TO TRAFFIC 48 HOURS LATER

The public demands good roads and streets, but is critical when construction barriers hinder convenience and business for long. That's why contractors and the public officials of Harrisburg, Pa., used Lehigh Early Strength Cement. It makes better, denser concrete that often can be opened to traffic in 24 to 48 hours.

At Buffalo, N. Y., during sewer construction, when rock faults permitted a bubbling spring to enter an open cofferdam, Lehigh Early Strength Cement quickly met the emergency. Its extreme plasticity made it easy to fill the fissures completely when the grout was pumped. Its quick hardening enabled the job excavation to go ahead in 48 hours.

at any time convenient to the owner and with a minimum of inconvenience and interruption to business.

Improvements to store properties may be made, sidewalks laid, etc., without extended use of barriers, which mean inconvenience to the public and consequent loss of business. Often such alterations, repairs and improvements can be made over night, or at the week-end, to eliminate entirely all interruption to business.

For Architects and Engineers

Quick service strength concrete speeds construction. It enables the coordination of job schedules. Reduced costs frequently result. Earlier completion of work results in increased satisfaction to clients. It opens up opportunities for additional work which depends upon speed in construction.

For Contractors and Builders

Quick service strength concrete reduces labor and equipment costs. It quickly releases forms for re-use, thus reducing the number needed. The expense of wetting down concrete for long curing is eliminated. It reduces expenses, such as overhead and interest charges, on an entire project because of earlier completion. It enables earlier settlement, and releases labor and equipment quickly for use elsewhere. It increases job efficiency, assists in coordinating construction schedules, helps to make up lost time on a job and to eliminate penalties for late completion. It often helps earn bonuses for earlier delivery of construction to owners.

Of especial importance is the fact that the sooner construction is completed and delivered to the owner, the sooner the contractor obtains settlement and regains the use of his capital.

Quick service strength concrete cuts cost of construction of certain types of work. For instance, in highways, quickly completed portions of the work can be put into use for trucking of materials and moving of equipment. In building construction, where steel erection, masonry construction, etc., await the curing of concrete in foundations, abutments, beams, arches, or other key portions of the work, early strength concrete minimizes such delays and makes possible practically continuous operation.

In cold weather it saves money by curtailing the use of heating plant for aggregate and water; it reduces the expense of heat curing by one-half to one-third—fewer salamanders and less fuel are required; housing and tarpaulin protection are reduced to a minimum.

In the construction of the Tuberculosis Sanitarium at Butler, Pa., the contractors used Lehigh Early Strength Cement for columns, beams, and slabs. The concrete met full specified strength requirements 23½ days quicker than normal cement, allowed form removal as much as 14 days earlier, eliminated most of the usual heat-protection time, and speeded up the whole job. On the cost sheet, all this time saving showed in lower form costs, less heat-curing expense, reduced overhead.

To cash in on fall trade, the Arnold Constable Company insisted upon quick construction in the erection of their new building. Lehigh Early Strength Cement was used in the foundations, to make quicker service strength concrete so that the erection of the superstructure could proceed promptly. Steel erectors were on the job ten days after the first concrete was poured. The entire building was completed 30 days sooner.

For Public Works

Quick service strength concrete meets the necessity for public convenience, safety, and economy. For highway and street construction it eliminates hazardous detours; it reduces the time when merchants may lose trade because of road and street repairs; it opens intersections quickly, providing arteries for all traffic, including fire apparatus. It makes possible quick relief from the emergencies of flood, earthquake, landslides, watermain breaks, cave-ins, and public utility failures.

Public Utilities

Quick service strength concrete reduces the hazards and expense of long disrupted railroad traffic. Right-of-way maintenance and repairs resulting from damage by landslides, floods, or the ravages of winter may be quickly made. Grade-crossing elimination is speeded up and public inconvenience is reduced to a minimum.

Street railways can make repairs in thoroughfares with minimum inconvenience; central stations can do conduit work expeditiously and make installations and repairs in power plants with minimum interruption to public service.

Concrete Products

Manufacturers of concrete products use Lehigh Early Strength Cement to obtain high quality with low production cost. Because of reduced manufacturing time, low inventories of finished products are carried. High production volume is possible with minimum investment in machinery, equipment, manufacturing and yard space. Filling of emergency orders is expedited.

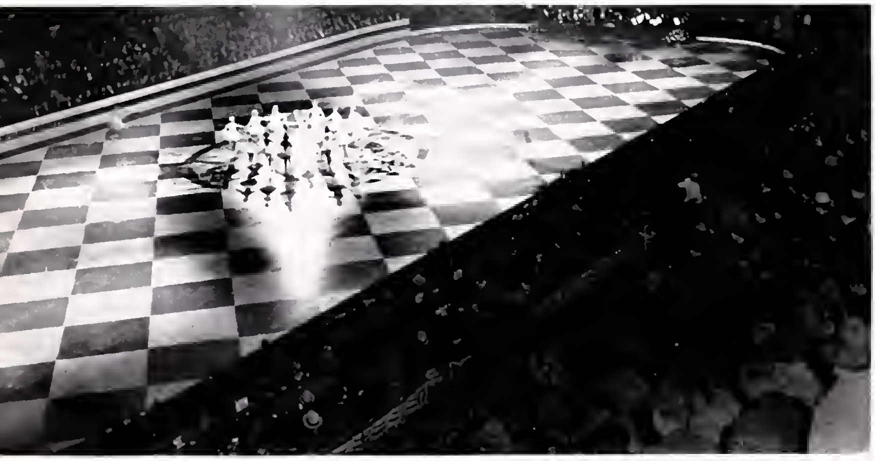
Petroleum Production

Quick service strength cement used for cementing casings in oil wells protects against collapse and erosion and makes it possible to resume drilling the next day. Its extreme plasticity makes it flow easily to fill all voids around the casing.

Tanks, Vats, Reservoirs, Pools, Dams

In every case where impermeability is required, Lehigh Early Strength Cement produces concrete of maximum density. It is ground to extreme fineness; can be used with minimum water content; easily produces a plastic and workable mixture,

The destructive force of flow tide was successfully combatted by pouring concrete piles for this power plant in Portland, Me., with Lehigh Early Strength Cement. Concrete was poured at ebb tide—six hours later, at high tide, because of quick curing in the early stages, piles were hard enough to withstand damage.



In the erection of Cleveland's Sports Arena the ten miles of refrigerant piping was embedded in concrete. A requirement was that terrazzo be laid on concrete within 30 minutes after pouring. Lehigh Early Strength Cement was used. The concrete was poured and the terrazzo surface laid in 36 hours. Within three days the grinding of the terrazzo started.

which, when filling the forms, compacts thoroughly without segregation of the materials. It also provides the advantage of earlier use of the construction.

Cement Mortar and Stucco

Lehigh Early Strength Cement, because of its extreme plasticity, makes stucco and mortar of a "fatty" consistency, which works smoothly under the trowel, thereby increasing the speed of use. The early hardening quality is of further advantage; stucco requires minimum wetting down; in masonry work, the load may be applied quickly; floor tile and terrazzo may be laid without delay.

Surface Appearance

Concrete made with Lehigh Early Strength Cement frequently requires no surface treatment after the removal of forms. Its dense, impervious surface of uniform color gives concrete a fine appearance. Where color effects and ornamental treatment are introduced, a minimum of hand labor is required after removal of the forms. Rock pockets and honeycombs are rare in concrete made with Lehigh Early Strength Cement.

When to Use Lehigh Early Strength Cement

Under similar conditions and temperature, Lehigh Early Strength Cement will produce concrete of the same strength in one-third to one-fifth the time required when normal portland cement is used. Therefore, when speed is necessary or adds to convenience, it is the logical choice.

For concrete of maximum density, whether or not speed is a factor, it provides a safer, surer means of obtaining the desired result.

Early completion is not always the determining factor. On practically every operation during the course of work extra speed is often necessary in some portion to coordinate the operations of the various building trades. For instance, until substructure concrete has attained safe, load-bearing strength, steel erection, superstructure masonry, and floors are often delayed. Fluctuating temperatures, weather conditions, labor shortage, transportation delays, or other factors may slow up the schedule—such lost time may be made up by finishing partially completed work with concrete made with Lehigh Early Strength Cement. The original job schedule may thus be regained.

LEHIGH EARLY STRENGTH CEMENT

Only a stone's throw from the Mississippi River, this modern, all-concrete house had to have a watertight cellar. Lehigh Early Strength Cement was used to get concrete of easy workability, a plastic mass that would flow easily to fill voids—better, denser concrete for an enduring watertight wall.

For unusual and difficult engineering construction, quick service concrete gives valuable help. Typical of its adaptability and economy was this use of Lehigh Early Strength Cement for paving the new 20-foot wide concrete road across tidewater marshes on the old Spanish trail in Mississippi. Each day 500 feet of one lane was closed, prepared and poured, and the next morning opened to traffic.

In other cases, where early completion is not essential, more frequently than not the obtaining of high early strength concrete effects economies in labor, form lumber, heat curing, interest charges, and overhead, which are decided advantages. Such savings can best be determined by making up two estimates for a given project—one figuring on the use of Lehigh Early Strength Cement, and the other figuring on the use of normal Lehigh Cement.

For any concrete work, from the small patching job to the great engineering construction project, Lehigh Early Strength Cement is used for any one or all of these advantages:

1. Speed—service strength concrete in a fraction of the time required when normal portland cement is used. For most purposes concrete made with Lehigh Early Strength is serviceable twenty-four hours after placing.
2. Great density—better consolidation.
3. Impermeability.
4. Excellent plasticity or workability.

To simplify consideration of the use of Lehigh Early Strength Cement, answers are given to questions which are sometimes asked.

What is the Difference Between "Setting" and "Hardening"?

"Setting" is the stiffening of a cement mixture and does not mark a definite change in the manner of behavior of the cement.

"Hardening" is that condition in a cement mixture when chemical reactions begin to take place and the mass loses its plasticity.

The following quotation from The Concrete Primer, prepared by F. R. McMillan and published by The American Concrete Institute, further clarifies the difference between "setting" and "hardening": "Among the other tests for cement, there is a test for 'time of setting' in which the initial and final set are determined by the application of the vicat or Gillmore needles to the smooth surface of a pat of cement paste. The application of both of these methods consists in determining the time when the paste has stiffened to a definite degree as indicated by the failure of the needles to penetrate a prescribed amount or to make appreciable indentations on the surface. The weights and areas are purely arbitrary and the conditions of hardness, which identify the periods selected for the initial and final set,

LEHIGH EARLY STRENGTH CEMENT

Lexington Avenue, New York City. Paving half at a time kept street open constantly. Traffic on 24-hour concrete. Entire operation completed in three-fourths the contract time.

Lehigh Early Strength Cement was used for arch keys in building the Calvert Street Bridge across Rock Creek, Washington, D. C. The contractor saved 15 days in time and $3,500 in reduced labor costs, form costs, and overhead.

Worthington, Ohio, used Lehigh Early Strength Cement in these water-treatment tanks to obtain concrete of maximum density and minimum effect from lime solution used in the water-treatment process.

ARE ONLY PASSING STAGES OF THE HARDENING PROCESS, AND ARE NOT POINTS THAT MARK DEFINITE CHANGES IN THE MANNER OF BEHAVIOR OF THE CEMENT."

Is Lehigh Early Strength Cement Quick Setting?

No. The American Society for Testing Materials specification for "time of setting" is the same for standard portland cement and for high early strength portland cement. Lehigh Early Strength Cement meets the specification. More than ample time elapses, before stiffening begins, to transport the mixture, to place it and properly consolidate the mass. Lehigh Early Strength Cement is used in large quantities for "ready-mix" concrete, which is often transported for many miles before placing. During the first few hours after mixing concrete with Lehigh Early Strength Cement its condition, to all appearances, is similar to that of concrete made with normal portland cement.

Why Does Lehigh Early Strength Cement Make Concrete of Great Density?

Because of its extreme fineness, more thorough hydration of the cement particles is obtained, thus facilitating the effectiveness of the cement paste in coating the aggregates and filling the voids. The finest quality concrete must have maximum density to provide a well-consolidated plastic mass which will flow without segregation to fill forms.

What Effect Has Density on Impermeability?

Density and impermeability are practically the same. Dense concrete is watertight because, with thorough cement paste coating of the sand particles and in turn the thorough coating of the aggregate and the filling of all the voids, porosity is eliminated. Thus dense concrete, so easy to obtain with Lehigh Early Strength Cement, is impervious to water and withstands the ravages of weather and time. Dense concrete provides an attractive surface of uniform color, a particular advantage for exposed concrete from an architectural standpoint. Dense concrete frequently requires no surface rubbing to be pleasing to the eye.

What Relation Has Density to Plasticity?

Plasticity is a vital quality that is obtainable only in dense concrete. Plasticity is that quality in concrete which renders

LEHIGH EARLY STRENGTH CEMENT

By using Lehigh Early Strength Cement instead of normal portland cement for dormitory at Cornell College, a Mt. Vernon, Iowa, contractor saved the cost of two carloads of form lumber, and reduced overhead on the job $678. Construction time was shortened by 15 days.

Auto Hotel, Bloomington, Ill. The temperature averaged 20° F. when concrete was poured for the first two floors. In three days concrete had cured sufficiently to permit removal of forms and further construction to proceed. This resulted in reducing construction time by 8 days and in a saving of $1,000.

it easily molded into a compact, closely knit mass which does not crumble but flows sluggishly and which in its fresh condition changes form slowly upon the removal of any mold. Dense concrete made with Lehigh Early Strength Cement is plastic, smooth, and easily workable; it spades readily into place in the forms, and its "buttery" consistency makes it easy to trowel to a fine finish.

Will Concrete Made With Lehigh Early Strength Cement Bond With Concrete Made With Normal Portland Cement?

Yes. Under any conditions concrete made with Lehigh Early Strength Cement bonds satisfactorily with any other concrete made with any portland cement so long as proper procedure is followed.

Does Lehigh Early Strength Cement Develop Early Strength When Placed Under Water?

Yes. Under any conditions where concrete may be placed practically, concrete made with Lehigh Early Strength Cement will reach service strength three to five times as rapidly as concrete made with normal portland cement under the same conditions.

Can Calcium Chloride be Added to Concrete Made With Lehigh Early Strength Cement?

Yes. Prepare the solution and use it exactly as for standard portland cement. While it is not often considered necessary, early strength concrete will develop still greater strength at the early ages when calcium chloride is used.

At temperatures up to 60° F., two pounds of calcium chloride per bag of cement is recommended, and if for any reason it is ever desirable to use it at curing temperatures of 65° F., or better, a solution providing not more than 1½ pounds per bag of cement should be used.

What Is the Color of Lehigh Early Strength Cement?

It is similar in color to normal Lehigh Cement, but produces a concrete slightly lighter in color because of the extreme fineness to which it is ground. Of course, the resulting color of concrete is influenced also by the richness of the mix and the aggregates. The pleasing, uniform, light gray tone of concrete made with Lehigh Early Strength Cement is an advantage for exposed surfaces.

ESTIMATING DATA

For convenience in determining the comparative advantages of Lehigh Early Strength Cement and normal portland cement, the following tables are offered. For explanatory notes and typical determinations which can be made from the data, see pages 23 to 31.

1" GRAVEL USING **NORMAL** LEHIGH PORTLAND CEMENT

Sacks Cement per Cu. Yd.	Concrete Consistency	W/C Ratio Gals. per Sack	MATERIALS PER CUBIC YARD By Weight: Sand Lbs.	By Weight: Gravel Lbs.	By Weight: Added Water Lbs.	By Volume: Sand Cu. Ft.	By Volume: Gravel Cu. Ft.	By Volume: Added Water Gals.	ESTIMATED STRENGTH LBS. PER SQ. INCH 7 Days	28 Days
4	Wet	9.75	1520	1840	253	17.1	18.6	30.4	1200	2000
4	Med.	9.00	1550	1880	226	17.4	19.0	27.1	1400	2300
4	Stiff	8.25	1580	1920	200	17.8	19.3	24.0	1700	2700
5	Wet	7.80	1420	1860	258	15.9	18.8	31.0	1900	2800
5	Med.	7.20	1440	1900	231	16.2	19.2	27.7	2200	3200
5	Stiff	6.60	1470	1940	205	16.6	19.6	24.6	2500	3600
6	Wet	6.50	1320	1880	262	14.8	19.0	31.4	2500	3700
6	Med.	6.00	1340	1920	236	15.1	19.4	28.3	2800	4000
6	Stiff	5.50	1370	1960	210	15.4	19.8	25.2	3200	4400
7	Wet	5.57	1220	1890	267	13.7	19.1	32.0	3100	4400
7	Med.	5.14	1240	1930	241	14.0	19.5	28.9	3400	4800
7	Stiff	4.71	1270	1970	215	14.3	19.9	25.8	3700	5200

Based on Portland Cement Association Test Data. These figures are for moist curing at 70° F. For data on concrete for lower temperatures, see pages 29 and 31.

1" GRAVEL USING LEHIGH **EARLY STRENGTH** PORTLAND CEMENT

Sacks Cement per Cubic yard	Concrete Consistency	W/C Ratio Gals. per Sack	MATERIALS PER CUBIC YARD By Weight: Sand Lbs.	By Weight: Gravel Lbs.	By Weight: Added Water Lbs.	By Volume: Sand Cu. Ft.	By Volume: Gravel Cu. Ft.	By Volume: Added Water Gals.	ESTIMATED STRENGTH LBS. PER SQ. INCH 1 Day	3 Days	7 Days	28 Days
4	Wet	9.75	1450	1910	256	16.3	19.3	30.7	500	1300	2000	2600
4	Med.	9.00	1480	1940	230	16.6	19.6	27.6	650	1600	2300	2900
4	Stiff	8.25	1510	1980	203	17.0	20.0	24.4	800	1900	2700	3300
5	Wet	7.80	1350	1920	261	15.1	19.4	31.3	1000	2100	2800	3600
5	Med.	7.20	1380	1960	234	15.5	19.8	28.1	1200	2400	3200	4100
5	Stiff	6.60	1400	2000	208	15.8	20.3	25.0	1400	2800	3600	4500
6	Wet	6.50	1250	1940	266	14.0	19.6	31.9	1500	2800	3700	4600
6	Med.	6.00	1280	1980	239	14.3	20.0	28.7	1700	3100	4000	5000
6	Stiff	5.50	1300	2020	213	14.6	20.4	25.6	1900	3400	4400	5500
7	Wet	5.57	1150	1950	270	13.0	19.7	32.4	1800	3400	4400	5400
7	Med.	5.14	1180	2000	244	13.2	20.2	29.3	2100	3700	4800	5800
7	Stiff	4.71	1200	2040	218	13.5	20.6	26.2	2400	4000	5200	6200

Based on Portland Cement Association Test Data. These figures are for moist curing at 70° F. For data on concrete for lower temperatures, see pages 29 and 31.

LEHIGH EARLY STRENGTH CEMENT

1" STONE USING **NORMAL** LEHIGH PORTLAND CEMENT

			MATERIALS PER CUBIC YARD By Weight			By Volume			ESTIMATED STRENGTH LBS. PER SQ. INCH	
Sacks Cement per Cu. Yd.	Concrete Consistency	W/C Ratio Gals. per Sack	Sand Lbs.	Stone Lbs.	Added Water Lbs.	Sand Cu. Ft.	Stone Cu. Ft.	Added Water Gals.	7 Days	28 Days
4	Wet	9.75	1760	1610	241	19.8	16.3	28.9	1200	2000
4	Med.	9.00	1800	1640	214	20.2	16.6	25.7	1400	2300
4	Stiff	8.25	1830	1680	188	20.6	16.9	22.6	1700	2700
5	Wet	7.80	1650	1640	246	18.6	16.5	29.5	1900	2800
5	Med.	7.20	1680	1670	220	18.9	16.9	26.4	2200	3200
5	Stiff	6.60	1720	1700	193	19.3	17.2	23.2	2500	3600
6	Wet	6.50	1540	1660	251	17.3	16.8	30.1	2500	3700
6	Med.	6.00	1580	1690	225	17.7	17.1	27.0	2800	4000
6	Stiff	5.50	1610	1730	198	18.1	17.5	23.8	3200	4400
7	Wet	5.57	1440	1680	256	16.2	16.9	30.7	3100	4400
7	Med.	5.14	1470	1710	230	16.6	17.3	27.6	3400	4800
7	Stiff	4.71	1500	1750	203	16.9	17.7	24.4	3700	5200

Based on Portland Cement Association Test Data. These figures are for moist curing at 70° F. For data on concrete for lower temperatures, see pages 29 and 31.

1" STONE USING LEHIGH **EARLY STRENGTH** PORTLAND CEMENT

			MATERIALS PER CUBIC YARD By Weight			By Volume			ESTIMATED STRENGTH LBS. PER SQ. INCH			
Sacks Cement per Cubic yard	Concrete Consistency	W/C Ratio Gals. per Sack	Sand Lbs.	Stone Lbs.	Added Water Lbs.	Sand Cu. Ft.	Stone Cu. Ft.	Added Water Gals.	1 Day	3 Days	7 Days	28 Days
4	Wet	9.75	1690	1680	244	19.0	16.9	29.3	500	1300	2000	2600
4	Med.	9.00	1730	1710	218	19.4	17.3	26.2	650	1600	2300	2900
4	Stiff	8.25	1760	1740	191	19.8	17.6	22.9	800	1900	2700	3300
5	Wet	7.80	1580	1700	250	17.8	17.2	30.0	1000	2100	2800	3600
5	Med.	7.20	1620	1740	223	18.2	17.5	26.8	1200	2400	3200	4100
5	Stiff	6.60	1650	1770	196	18.5	17.9	23.5	1400	2800	3600	4500
6	Wet	6.50	1480	1720	255	16.6	17.4	30.6	1500	2800	3700	4600
6	Med.	6.00	1510	1760	228	17.0	17.8	27.4	1700	3100	4000	5000
6	Stiff	5.50	1540	1800	202	17.3	18.1	24.2	1900	3400	4400	5500
7	Wet	5.57	1380	1740	259	15.5	17.6	31.1	1800	3400	4400	5400
7	Med.	5.14	1410	1780	233	15.8	17.9	28.0	2100	3700	4800	5800
7	Stiff	4.71	1440	1810	207	16.1	18.3	24.8	2400	4000	5200	6200

Based on Portland Cement Association Test Data. These figures are for moist curing at 70° F. For data on concrete for lower temperatures, see pages 29 and 31.

2" GRAVEL USING **NORMAL** LEHIGH PORTLAND CEMENT

Sacks Cement per Cu. Yd.	Concrete Consistency	W/C Ratio Gals. per Sack	MATERIALS PER CUBIC YARD By Weight			By Volume			ESTIMATED STRENGTH LBS. PER SQ. INCH	
			Sand Lbs.	Gravel Lbs.	Added Water Lbs.	Sand Cu. Ft.	Gravel Cu. Ft.	Added Water Gals.	7 Days	28 Days
4	Wet	9.00	1410	2010	233	15.8	20.3	28.0	1400	2300
4	Med.	8.25	1440	2050	207	16.1	20.7	24.8	1700	2700
4	Stiff	7.50	1460	2090	180	16.4	21.1	21.6	2000	3000
5	Wet	7.20	1310	2030	238	14.7	20.5	28.6	2200	3200
5	Med.	6.60	1330	2070	211	15.0	20.9	25.3	2500	3600
5	Stiff	6.00	1360	2110	185	15.3	21.3	22.2	2800	4000
6	Wet	6.00	1210	2040	242	13.6	20.6	29.0	2800	4000
6	Med.	5.50	1230	2090	216	13.9	21.1	25.9	3200	4400
6	Stiff	5.00	1260	2130	190	14.1	21.5	22.8	3500	4900
7	Wet	5.14	1110	2060	247	12.5	20.8	29.6	3400	4800
7	Med.	4.71	1140	2100	221	12.8	21.2	26.5	3700	5200
7	Stiff	4.29	1160	2140	195	13.0	21.7	23.4	3900	5500

Based on Portland Cement Association Test Data. These figures are for moist curing at 70° F. For data on concrete for lower temperatures, see pages 29 and 31.

2" GRAVEL USING LEHIGH **EARLY STRENGTH** PORTLAND CEMENT

Sacks Cement per Cubic yard	Consistency	W/C Ratio Gals. per Sack	MATERIALS PER CUBIC YARD By Weight			By Volume			ESTIMATED STRENGTH LBS. PER SQ. INCH			
			Sand Lbs.	Gravel Lbs.	Added Water Lbs.	Sand Cu. Ft.	Gravel Cu. Ft.	Added Water Gals.	1 Day	3 Days	7 Days	28 Days
4	Wet	9.00	1340	2080	236	15.0	21.0	28.3	650	1600	2300	2900
4	Med.	8.25	1360	2120	210	15.3	21.4	25.2	800	1900	2700	3300
4	Stiff	7.50	1390	2160	184	15.6	21.8	22.1	1100	2200	3000	3800
5	Wet	7.20	1240	2100	241	13.9	21.2	28.9	1200	2400	3200	4100
5	Med.	6.60	1260	2140	215	14.2	21.6	25.8	1400	2800	3600	4500
5	Stiff	6.00	1290	2180	189	14.5	22.0	22.7	1700	3100	4000	5000
6	Wet	6.00	1140	2110	246	12.8	21.3	29.5	1700	3100	4000	5000
6	Med.	5.50	1160	2150	220	13.1	21.8	26.4	1900	3400	4400	5500
6	Stiff	5.00	1190	2200	193	13.3	22.2	23.2	2200	3800	4900	5800
7	Wet	5.14	1050	2120	250	11.8	21.4	30.0	2100	3700	4800	5800
7	Med.	4.71	1070	2160	224	12.0	21.8	26.9	2400	4000	5200	6200
7	Stiff	4.29	1090	2210	198	12.3	22.3	23.8	2600	4300	5500	6600

Based on Portland Cement Association Test Data. These figures are for moist curing at 70° F. For data on concrete for lower temperatures, see pages 29 and 31.

2" STONE USING **NORMAL** LEHIGH PORTLAND CEMENT

Sacks Cement per Cu. Yd.	Concrete Consistency	W/C Ratio Gals. per Sack	MATERIALS PER CUBIC YARD By Weight			By Volume			ESTIMATED STRENGTH LBS. PER SQ. INCH	
			Sand Lbs.	Stone Lbs.	Added Water Lbs.	Sand Cu. Ft.	Stone Cu. Ft.	Added Water Gals.	7 Days	28 Days
4	Wet	9.00	1660	1780	221	18.6	18.0	26.5	1400	2300
4	Med.	8.25	1690	1810	195	19.0	18.3	23.4	1700	2700
4	Stiff	7.50	1720	1850	168	19.3	18.7	20.2	2000	3000
5	Wet	7.20	1550	1800	226	17.4	18.2	27.1	2200	3200
5	Med.	6.60	1580	1840	200	17.7	18.6	24.0	2500	3600
5	Stiff	6.00	1610	1870	173	18.1	18.9	20.8	2800	4000
6	Wet	6.00	1440	1820	231	16.2	18.4	27.7	2800	4000
6	Med.	5.50	1470	1860	205	16.6	18.8	24.6	3200	4400
6	Stiff	5.00	1500	1900	178	16.9	19.2	21.4	3500	4900
7	Wet	5.14	1340	1840	236	15.1	18.6	28.3	3400	4800
7	Med.	4.71	1370	1880	210	15.4	19.0	25.2	3700	5200
7	Stiff	4.29	1400	1920	183	15.7	19.4	22.0	3900	5500

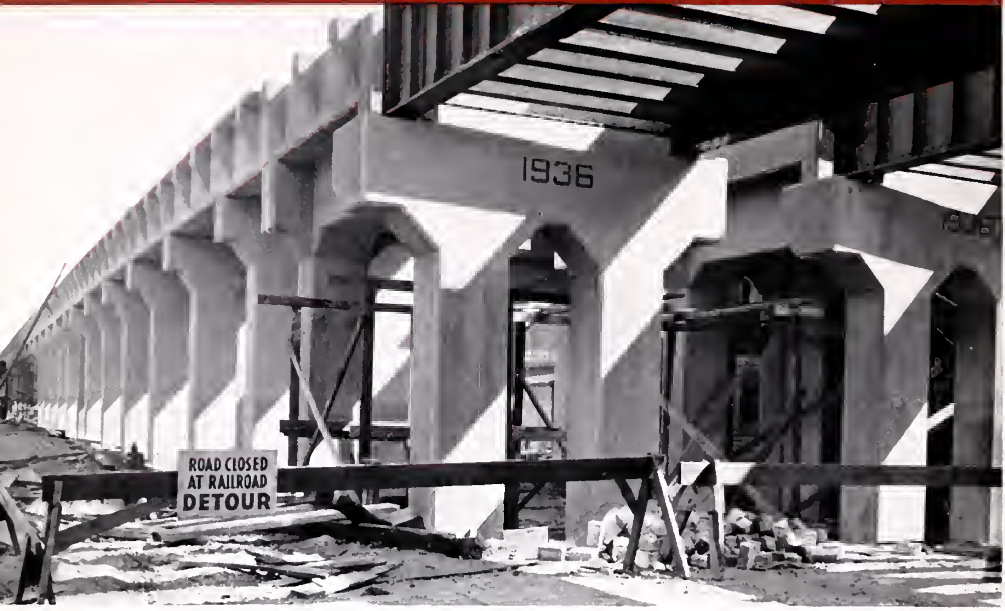
Based on Portland Cement Association Test Data. These figures are for moist curing at 70° F. For data on concrete for lower temperatures, see pages 29 and 31.

2" STONE USING LEHIGH **EARLY STRENGTH** PORTLAND CEMENT

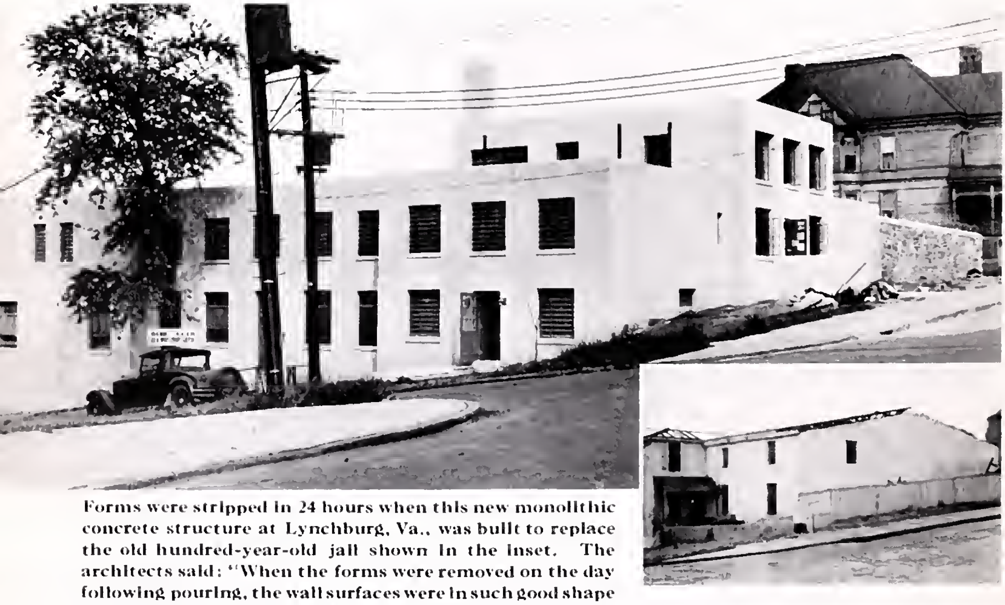
Sacks Cement per Cubic yard	Concrete Consistency	W/C Ratio Gals. per Sack	MATERIALS PER CUBIC YARD By Weight			By Volume			ESTIMATED STRENGTH LBS. PER SQ. INCH			
			Sand Lbs.	Stone Lbs.	Added Water Lbs.	Sand Cu. Ft.	Stone Cu. Ft.	Added Water Gals.	1 Day	3 Days	7 Days	28 Days
4	Wet	9.00	1590	1840	224	17.8	18.6	26.9	650	1600	2300	2900
4	Med.	8.25	1620	1880	198	18.2	19.0	23.8	800	1900	2700	3300
4	Stiff	7.50	1650	1920	171	18.5	19.4	20.5	1100	2200	3000	3800
5	Wet	7.20	1480	1870	230	16.6	18.9	27.6	1200	2400	3200	4100
5	Med.	6.60	1510	1900	203	17.0	19.2	24.4	1400	2800	3600	4500
5	Stiff	6.00	1540	1940	177	17.3	19.6	21.2	1700	3100	4000	5000
6	Wet	6.00	1380	1890	234	15.5	19.0	28.1	1700	3100	4000	5000
6	Med.	5.50	1400	1920	208	15.8	19.4	25.0	1900	3400	4400	5500
6	Stiff	5.00	1430	1960	182	16.1	19.8	21.8	2200	3800	4900	5800
7	Wet	5.14	1280	1900	239	14.3	19.2	28.7	2100	3700	4800	5800
7	Med.	4.71	1300	1940	213	14.6	19.6	25.6	2400	4000	5200	6200
7	Stiff	4.29	1330	1980	187	14.9	20.0	22.4	2600	4300	5500	6600

Based on Portland Cement Association Test Data. These figures are for moist curing at 70° F. For data on concrete for lower temperatures, see pages 29 and 31.

LEHIGH EARLY STRENGTH CEMENT



Three months' time and over $4,000 were saved by using Lehigh Early Strength Cement for grade-crossing elimination work during the severe winter of 1935–36 for Staten Island Rapid Transit Co., at Stapleton, N. Y. The contractors made their savings in form costs and overhead. Forty fewer form sets were needed than would have been required with normal portland cement.



Forms were stripped in 24 hours when this new monolithic concrete structure at Lynchburg, Va., was built to replace the old hundred-year-old jail shown in the inset. The architects said: "When the forms were removed on the day following pouring, the wall surfaces were in such good shape and so free of honeycombs that we seriously considered eliminating the rubbing which was specified. However, the walls were rubbed, but with a minimum of labor."

EXPLANATORY NOTES

Pertaining to Tables on Pages 18 to 21

Quantities

Quantities of materials are based on aggregate of average grading, specific gravity 2.65. Sand is assumed to contain 5% free moisture, weighing 89 lbs. per cu. ft., damp and loose. Gravel and stone are assumed to be surface dry, weighing 99 lbs. per cubic foot, measured loose. Mixes are based on cement content (sacks per cu. yd.) and cover the range of all ordinary uses of concrete.

Strengths

The concrete strengths obtained on any given job depend on existing conditions—particularly prevailing temperatures and completeness of curing. Job strengths, therefore, do not always agree with those obtained in the laboratory. The strengths given in the tables starting on page 18 are taken from Portland Cement Association test data and are considered conservative for concretes placed and cured at 70° F.

Proportions

Arbitrary proportions such as 1:3:6, etc., are not used. Cement content is expressed in sacks per cubic yard. Thus the 4, 5, 6 and 7 sacks per yard which appear as basic figures are roughly comparable to the old accepted proportions of 1:3:6; 1:2½:5; 1:2:4; and 1:1½:3. The sacks per cu. yd. method is more indicative of the quality of concrete desired.

Example: A cement content of 6 sacks per cu. yd. will make a good grade of concrete. The tables offer 12 different mixtures (each with 6 sacks of cement per cu. yd.) from which a choice is made depending upon the consistency desired and the type and size of aggregate available. The same wide variety of mixtures is shown for both normal portland cement and early strength portland cement, and the tabulation is such that strengths to be attained with both types of cement may be instantly compared.

Measurements

Quantities are given by both weight and volume. Materials may be bought by weight and used on the job by any convenient unit of measure. A sack of cement is rated as one cubic foot; volume proportions of aggregates are rated in cubic feet—thus the correct proportions are readily obtained if any smaller unit, such as a bucket, is used. Obviously, the number of sacks of

Polk County Highway Garage and Office Building, Balsam Lake, Wisconsin. At temperatures of from 20° F. below zero to 20° F. above, with minimum heat protection, forms were stripped in three days. This speed reduced form requirements one-half—a cash saving of $500. Heat-curing costs were $600 lower. Because of quicker completion, $900 was saved in the salaries of two supervisors for 60 days. The total cash saving was $2,000. Occupation by the county was 60 days earlier.

Contractor used Lehigh Early Strength Cement for swimming pool at Williamsport, Pa., to get better, denser watertight concrete and to cut costs. He saved $120 by re-using form lumber and saved $150 on overhead. The pool was used ten days sooner than would have been possible if it had been built with normal portland cement.

cement and the number of cubic feet of aggregates may be used as "parts," and the water may be added without measure to give desired consistency.

When mixes are stiffer than the expected consistency, it may be due to unfavorable grading, or drier sand than that upon which the tables are based. In such cases, only sufficient water to give the desired consistency should be added.

Selecting the Mix

Cement contents and consistencies recommended for various types of concrete made with normal portland cement and early strength portland cement are as follows:

Use of Concrete	Sacks of Cement Per Cubic Yard	Consistency of Mix	Days of Moist Curing Recommended at Temperatures of 70° F. or Over	
			With Early Strength Cement	With Normal Cement
Footing Foundations	4	Medium	1	5
Basement Walls	5	Medium	1	5
Sidewalks and Steps	5	Stiff	1	5
Driveways, Curbs, Etc.	5	Stiff	1	5
Watertight, for Pools, Tanks, Etc.	6	Medium	2	10
Structural Parts	6	Wet	1	5
Industrial Floors	7	Stiff	2	10

To determine the advantages of Lehigh Early Strength Cement it will be desirable to compare the relative strengths obtainable, in a given time, with the two types of cement. Such comparisons can be made by using tables on pages 18 to 21.

Example: Compare the expected strengths for a mix of medium consistency requiring 6 sacks of cement per cu. yd., using 1″ aggregate. (See tables, pages 18 and 19.)

Age of Concrete	Compressive Strength of Concrete Made With Normal Portland Cement	Compressive Strength of Concrete Made With Early Strength Portland Cement
1 day		*1700 lbs. per sq. in.
3 days		3100 lbs. per sq. in.
7 days	2800 lbs. per sq. in.	4000 lbs. per sq. in.
28 days	4000 lbs. per sq. in.	

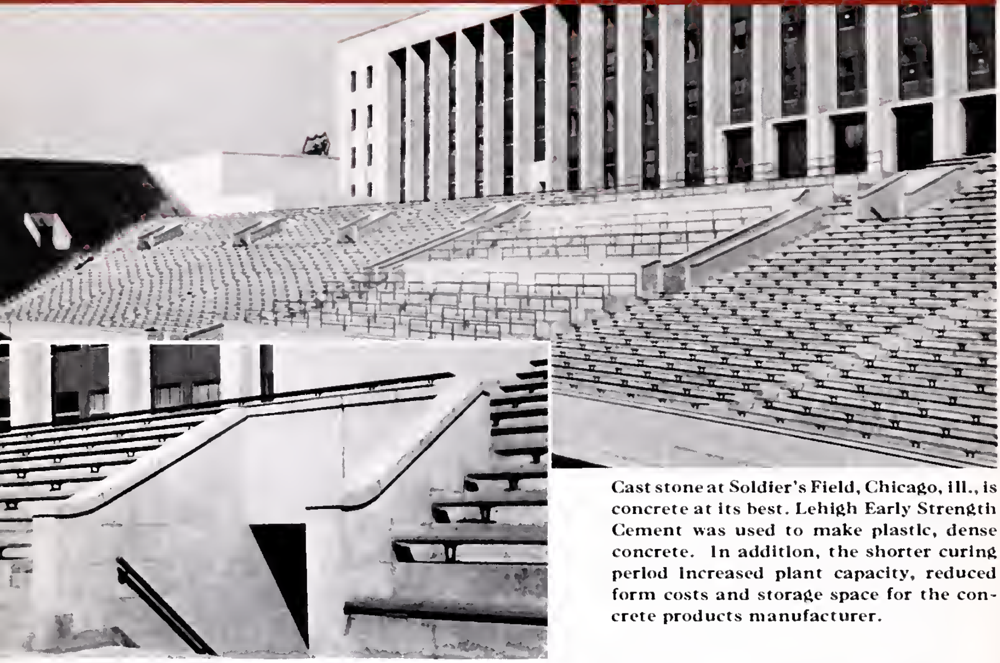
*After normal curing, for most uses forms could be removed and concrete put into service.

Typical Determinations Which May be Made From Tables

Example No. 1

A form removal strength of 2000 lbs. is required—with a 5 bag medium mix using normal portland cement, the forms must

LEHIGH EARLY STRENGTH CEMENT



Cast stone at Soldier's Field, Chicago, Ill., is concrete at its best. Lehigh Early Strength Cement was used to make plastic, dense concrete. In addition, the shorter curing period increased plant capacity, reduced form costs and storage space for the concrete products manufacturer.

Paved section by section, the Queens approach to Triborough Bridge, the main traffic artery from Queens County to upper New York, was opened to full traffic in 36 hours. The public was never inconvenienced during construction.

remain in place for 7 days. If, however, Lehigh Early Strength Cement is used in the same mix (5 bags medium consistency), forms can be removed at 3 days, or by using 7 bags of Lehigh Early Strength Cement in the same consistency of mix, the forms can be removed at 24 hours. The savings that may result from this earlier form removal, in dollars and cents, can thus be balanced against the added cost per cubic yard of concrete and a decision made.

Example No. 2

A cement content of 5½ bags per cubic yard, medium consistency, with 1″ gravel and Lehigh Early Strength Cement, is desired. Turn to page 18 for mixtures using 1″ gravel.

	Sand		Gravel		Water	
	Lbs.	Cu. Ft.	Lbs.	Cu. Ft.	Lbs.	Gals.
refer to 6 Medium, take off	1280	14.3	1980	20.0	239	28.7
and refer to 5 Medium, take off	1380	15.5	1960	19.8	234	28.1
then take the average for 5½ Medium	1330	14.9	1970	19.9	236	28.4

Strength calculations can be made in the same way.

Example No. 3

A wet consistency is necessary for proper placing and a 28-day strength of 4000 P.S.I. is necessary, using 1″ gravel and normal portland cement.

On page 18, under 1″ gravel, using normal portland cement, find the figure closest to 4000 P.S.I. for 28-day strength with wet consistency.

Note that a 7 bag mix of wet consistency will provide 4400 P.S.I. and a 6 bag mix of wet consistency will provide 3700 P.S.I. Therefore a 6½ bag wet mix should give the desired 4000 P.S.I.

Calculate for the various quantities as described above.

Example No. 4

Find the one bag quantities for a 6 bag medium consistency mix, using 1″ gravel and Lehigh Early Strength Cement. See page 18.

The cubic yard quantities are:
Gravel 1980 lbs.—20.0 cu. ft.
Sand 1280 lbs.—14.3 cu. ft.
Water 239 lbs.—28.7 gals.

Divide each by six to obtain the one sack batches as follows:
1 sack cement = 1 sack cement
213 lbs. sand = 2.4 cu. ft. sand
330 lbs. gravel = 3.3 cu. ft. gravel
40 lbs. of added water = 4.8 gallons of added water

LEHIGH EARLY STRENGTH CEMENT

The Museum of Modern Art, New York City. Tests conducted on the job under the engineers' supervision showed that, compared with normal portland cement, the required strengths could be obtained in one-third the time by using Lehigh Early Strength Cement. Column forms were stripped in 24 hours; floor slab forms in as short a period as 48 hours. The re-use of forms effected a saving of one-third in form costs. Floors were quickly used for storage of materials—further construction was continued without interruption. This complete co-ordination meant savings in overhead and expedited the entire job.

The public gained 14 weeks because Lehigh Early Strength Cement was used for the Poplar Street Overhead Bridge, Bluefield, W. Va., when cold weather set in. Construction time was reduced 14 weeks. Heat-curing costs were reduced 50 percent, fewer forms were needed because of quick re-use, and general overhead was 25 percent lower.

Example No. 5

For smaller batches—measured in boxes or buckets. Same mix, and from the previous figures in Example No. 4, the quantities would read:

1 bucket of cement
$2\frac{2}{5}$ buckets of sand
$3\frac{1}{3}$ buckets of gravel
Add water to obtain desired consistency

Example No. 6

Correct for specific gravity of aggregates:

When aggregates of specific gravity other than 2.65 are used, multiply the weights given in the various tables, pages 18 to 21, by the appropriate factor as indicated below:

For Specific Gravity	2.40	2.50	2.60	2.70	2.80	2.90	3.00
Multiply by	0.91	0.94	0.98	1.02	1.06	1.09	1.13

Effect of Low Temperatures on Concrete Strengths

Example No. 7

Low concrete temperatures and low curing temperatures slow up the strength of all concretes. The following table may be used as a guide to those strengths, in this way:

A six bag medium consistency concrete is to be placed, using Lehigh Early Strength Cement and 1″ stone.

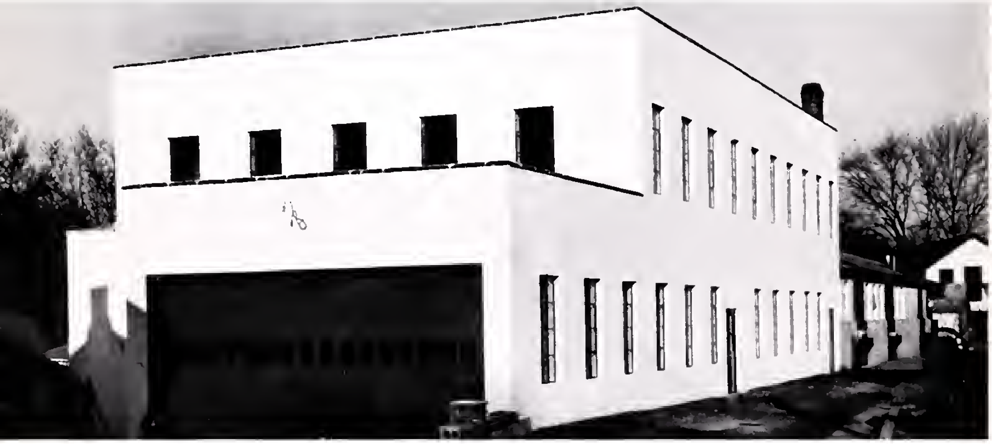
From the charts on page 19 we find that after moist curing at 70° F., the 3 day strength will be 3100 P.S.I. If the average concrete and curing temperature is to be 60° F., from the table below 60° F. at 3 days = 87% of 3100, or 2700 P.S.I. If the average concrete and curing temperature is to be 50° F., from the table below 50° F. at 3 days = 64% of 3100, or 2000 P.S.I.

<table>
<tr><th colspan="13">% of 70° Moist-Cured Compressive Strength NORMAL Portland Cement</th></tr>
<tr><th rowspan="2">Placed and cured at</th><th colspan="4">4½ Gals. Per Sack</th><th colspan="4">6 Gals. Per Sack</th><th colspan="4">9 Gals. Per Sack</th></tr>
<tr><th>1d.</th><th>3d.</th><th>7d.</th><th>28d.</th><th>1d.</th><th>3d.</th><th>7d.</th><th>28d.</th><th>1d.</th><th>3d.</th><th>7d.</th><th>28d.</th></tr>
<tr><td>60° F</td><td>68%</td><td>78%</td><td>82%</td><td>83%</td><td>65%</td><td>74%</td><td>79%</td><td>82%</td><td>61%</td><td>71%</td><td>78%</td><td>78%</td></tr>
<tr><td>50° F</td><td>28%</td><td>50%</td><td>60%</td><td>61%</td><td>22%</td><td>43%</td><td>52%</td><td>59%</td><td>14%</td><td>36%</td><td>51%</td><td>51%</td></tr>
<tr><th colspan="13">% of 70° Moist-Cured Compressive Strength EARLY STRENGTH Portland Cement</th></tr>
<tr><td>60° F</td><td>72%</td><td>88%</td><td>94%</td><td>94%</td><td>70%</td><td>87%</td><td>88%</td><td>93%</td><td>70%</td><td>85%</td><td>88%</td><td>94%</td></tr>
<tr><td>50° F</td><td>38%</td><td>72%</td><td>80%</td><td>88%</td><td>34%</td><td>64%</td><td>75%</td><td>84%</td><td>32%</td><td>66%</td><td>73%</td><td>85%</td></tr>
</table>

Based on "Temperature Effects on Compressive Strengths of Concrete," Timms and Withey, A. C. I. Journal, Vol. VI, No. 2.

LEHIGH EARLY STRENGTH CEMENT

For this service station at Moberly, Mo., the contractors used Lehigh Early Strength Cement as a cold weather safeguard. In 48 hours concrete cured beyond the danger of freezing.



Construction schedule had to be reduced from 95 days to 65 days. Lehigh Early Strength Cement was used to make quick service concrete. In 20 hours, forms from each pour were stripped and re-used. Steel and masonry erection followed without delay. At Middletown, N. Y., the contractor completed the job within the 65-day limit and, compared with the original schedule, cut his costs $450.

Through the winter of 1936–37, sub-zero temperatures presented a problem during construction of the Villa Sancta Scholastica. Lehigh Early Strength Cement was used. Construction time on the tower brickwork was reduced by eight days. On form erection costs alone the savings were $300.

These general precautions are recommended for winter concrete when temperatures below 50° F. are to be expected:

Down to 40° F.—Aggregates free of frost.
Heat water for concrete.
Protect concrete against heat loss overnight.

Down to 20° F.—Heat water and aggregates.
Remove snow and ice from forms.
Heat concrete to 70° F.
Protect concrete from heat loss up to 48 hours.

Below 20° F.—Heat water and aggregates.
Remove snow and ice from forms.
Heat concrete to 70° F.
Warm forms with steam, if available.
Protect concrete from heat losses up to 72 hours.

Further Information

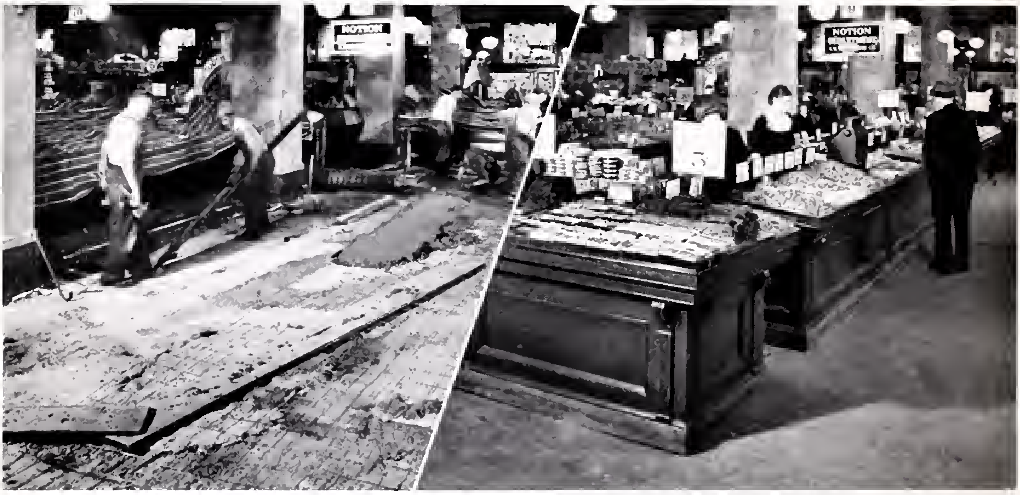
The material in this book is intended as a guide to assist in determining where the use of Lehigh Early Strength Cement will be advantageous. The information is necessarily general. For specific work, engineering and architectural design should govern procedure.

The Lehigh Service Department in no case provides plans or designs, but it invites inquiry for any information pertaining to concrete and its use under any conditions.

LEHIGH PORTLAND CEMENT COMPANY
Allentown, Pa., Chicago, Ill., Spokane, Wash.

Once the public was inconvenienced and storekeepers lost trade. Today quick service concrete sidewalks cure overnight.

Using Lehigh Early Strength Cement, this new concrete pavement carried heavy traffic 11 days after demolishing the old road.



8 P. M., work begun.

Next morning, business as usual.

Rehabilitation after the 1936 Pittsburgh flood required the Woolworth store to install a new floor. With Lehigh Early Strength Cement the floor was installed overnight. Tearing up the old floor was started at 8 P. M., the new floor finished at 2 A. M. At 8 A.M. merchandise was replaced, and the store opened at 9 A. M. ready for business.

Lehigh Early Strength Cement used to build loading platform in two sections. Each section was ready for heavy trucking 36 hours after placing the concrete.

Twenty-three tons of machinery placed on 24-hour-old concrete base. Pipe Line Division, Pure Oil Company.

AVERY
LIBRARY

Hepburn.—
51 E. 42 nd

LEHIGH
EARLY STRENGTH
CEMENT

What it is, what it does what it can be used for